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BCS2313

ARTIFICIAL INTELLIGENCE EXERCISES

**SEMESTER I SESSION 2024/2025**

**LECTURER’S NAME : Ts. Dr. Nur Shazwani Kamarudin**

**SECTION : 02**

**NAME : Hendianto Mohammad Farid**

**STUDENT ID : CB24153**

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**CASE BASED REASONING EXERCISE**

The Transportation Security Administration (TSA) began adding facial recognition technology to the security process at the airport across United States.Airport facial recognition aims to help the TSA more accurately identify known threats and prevent them from entering secure areas while making it easier for passengers to get through security efficiently. Their primary goal for this technology is to streamline the screening process of passengers. The idea is that by using facial recognition, they can focus on people who have higher threats scores rather than wasting time checking all passengers’ details. **Table 1** shows data stored in one of Los Angeles Airport's databases for the passenger recognition specifically focusing on details of each passengers using the biometric data. This database contains details of passengers that were detected to be a threat or not. Predict the passenger’s treat status (Table 2) and rounded your answer to **FOUR (4)** decimal places:

**Table 1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Passenger details** | **Age** | **International Travelling Frequency (annually)** | **Income (annually)** | **Treat Status** |
| Passenger 1 | 42 | 3 | 230000 | No |
| Passenger 2 | 25 | 7 | 55000 | Yes |
| Passenger 3 | 50 | 13 | 250000 | No |
| Passenger 4 | 30 | 22 | 82000 | No |

**Table 2**

|  |  |
| --- | --- |
| **Passenger Details** | **Passenger 5** |
| Age | 45 |
| International Travelling Frequency (annually) | 11 |
| Income (annually) | 150000 |
| Threat status | ? |

**Answer:**

1. First Cycle – **Retrieve**

In the first step of the Case-Based Reasoning (CBR) cycle, we need to retrieve cases from the case base that are similar to the current problem. The problem at hand involves predicting the threat status of Passenger 5 (Table 2) based on their attributes, age, International Travelling Frequency (annually), Income (annually), and threat status.

**Table 2**

|  |  |
| --- | --- |
| **Passenger Details** | **Passenger 5** |
| Age | 45 |
| International Travelling Frequency (annually) | 11 |
| Income (annually) | 150000 |
| Threat status | ? |

We will retrieve all existing cases from the database that have the same set of attributes to use for comparison. The retrieved cases are:

Table 1: Retrieved Cases

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Passenger details** | **Age** | **International Travelling Frequency (annually)** | **Income (annually)** | **Treat Status** |
| Passenger 1 | 42 | 3 | 230000 | No |
| Passenger 2 | 25 | 7 | 55000 | Yes |
| Passenger 3 | 50 | 13 | 250000 | No |
| Passenger 4 | 30 | 22 | 82000 | No |

These cases will serve as the basis for comparison to determine the most similar case to Passenger 5. By analyzing the similarities and differences in attributes such as age, travel frequency, and income, we can predict the threat status for Passenger 5.

1. Second Cycle – **Reuse**

In the second step of the Case-Based Reasoning (CBR) cycle, we aim to find the most similar case(s) from our case base to the new problem (Passenger 5) to predict the threat status. This involves several steps:

1. **Finding the Maximum and Minimum Values for Each Attribute**

First, we need to identify the maximum and minimum values for each attribute across all cases, including the new problem. This will be used to normalize the differences between attribute values.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Passenger details** | **Age** | **International Travelling Frequency (annually)** | **Income (annually)** | **Treat Status** |
| Passenger 1 | 42 | **3** | 230000 | No |
| Passenger 2 | **25** | 7 | 55000 | Yes |
| Passenger 3 | **50** | 13 | 250000 | No |
| Passenger 4 | 30 | **22** | 82000 | No |

1. **Calculating the Local Similarity (LS) for Each Attribute**

We use the following formula to calculate the local similarity between the problem and each case for every attribute:

a = Value of the attribute in the problem (Passenger 5)

b = Value of the attribute in the case from the case base

Max = Maximum value of the attribute

Min = Minimum value of the attribute

**Determining Attribute Weights**

Based on the context, the International Travelling Frequency is crucial for assessing threat levels. Therefore, we assign it a weight twice that of the other attributes:

Weight of Age (w₁): 1

Weight of International Travelling Frequency (w₂): 2 (FIX, w2 is 1)

Weight of Income (w₃): 1

The sum of the weights is:

**Calculations for Each Case**

**Passenger 1**

**Passenger 2**

**Passenger 3**

**Passenger 4**

**c) Comparing Global Similarity Scores**

Now, we compare the Global Similarity (GS) scores of all cases:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Passenger details** | **Age** | **International Travelling Frequency (annually)** | **Income (annually)** | **Treat Status** | **GS** |
| Passenger 1 | 42 | 3 | 230000 | No |  |
| Passenger 2 | 25 | 7 | 55000 | Yes |  |
| Passenger 3 | 50 | 13 | 250000 | No |  |
| Passenger 4 | 30 | 22 | 82000 | No |  |

**Passenger 3** has the highest Global Similarity score of 0.7692, indicating it is the most similar case to Passenger 5.

**d) Predicting the Threat Status for Passenger 5**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Passenger details** | **Age** | **International Travelling Frequency (annually)** | **Income (annually)** | **Treat Status** |
| **Passenger 5** | **45** | **11** | **150000** | **No** |

Since Passenger 3 is the most similar case and has a Threat Status of "No", we predict that Passenger 5 also has a Threat Status of "No".

1. Third Cycle – **Revise**

In this step, we assess whether the predicted solution—Passenger 5's threat status being "No"—is appropriate or requires any adjustments. Given that Passenger 5's attributes closely align with those of Passenger 3, who is not considered a threat, and considering there are only two possible threat statuses ("Yes" or "No"), the prediction seems accurate. Therefore, no revisions are necessary, and we accept the solution as is.

1. Fourth Cycle – **Retain**

Finally, we incorporate Passenger 5's case, along with the predicted threat status of "No," into the case base. By adding this new case to our database, we enhance the system's knowledge for future assessments. This updated case base will enable more accurate and efficient predictions when evaluating passengers with similar attributes in the future.

**Table 1 with added new case.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Passenger details** | **Age** | **International Travelling Frequency (annually)** | **Income (annually)** | **Treat Status** |
| Passenger 1 | 42 | 3 | 230000 | No |
| Passenger 2 | 25 | 7 | 55000 | Yes |
| Passenger 3 | 50 | 13 | 250000 | No |
| Passenger 4 | 30 | 22 | 82000 | No |
| **Passenger 5** | **45** | **11** | **150000** | **No** |

Conclusion:

The introduction of facial recognition technology by the Transportation Security Administration (TSA) aims to enhance security and streamline the screening process at airports. Using Case-Based Reasoning (CBR), we predicted the threat status of Passenger 5 based on their attributes: age, international traveling frequency, and annual income. The CBR process involved retrieving similar cases, reusing the knowledge from these cases, revising the solution, and retaining the case in the database for future use. Our analysis identified Passenger 3, who shares the highest similarity with Passenger 5, as the most relevant case. With **Passenger 3’s threat status marked as "No,"** we **predicted that Passenger 5 also poses no threat**.